Trip Characteristics and Travel Patterns of Suburban Residents

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Increasing traffic congestion in U.S. suburbs can be explained to a large degree by their rapid growth. Much is still to be learned, however, about the causes of and variations in traffic congestion. The results of investigations of variations in travel behavior across social groups and between locations are presented. The investigations were based on a mid-1989 mail-back survey of individuals residing in selected Chicago suburbs. Four prominent factors associated with traffic congestion are residence location, population aging, working women, and fixed work hours. Residence location in outer-ring, low-density, growing suburbs implies longer trips and more local trips because of low density and more employment opportunities, respectively. The average travel speed by automobile is higher for residents of growing suburbs, but because of longer commutes they still stay in traffic 25 percent longer than residents of stable suburbs. Population aging may offer some relief to suburban traffic congestion, not because older people travel less, but because they make better use of off-peak periods and shorter trips. Hence, their travel behavior may equalize use of the roadway infrastructure over the day. The increasing number of working women and mothers further contributes to congestion because long work trips are added to the large number of household maintenance trips made by women. The morning and evening peak periods remain short in duration. It would make a tremendous difference in peak loads and network performance if the observed 1½-hr peak were spread over 2½ to 3 hr.

Increasing traffic congestion in U.S. suburbs can be explained to a large degree by their rapid growth. Much is still to be learned, however, about the causes of and variations in traffic congestion. The resulting knowledge may be helpful in identifying promising solutions to these problems.

To expand our understanding of contemporary suburban travel, we explored the trip characteristics of individuals residing in selected Chicago suburbs using a mail-back survey conducted in the spring of 1989. The variations of several characteristics of individual travel behavior across social groups and between locations (i.e., outer-ring, low density, growing suburbs and inner-ring, high density, stable suburbs) were investigated.

Initial analysis using aggregate census data enabled us to classify suburbs into growing and stable (*1,2*). From the original sample of 30 suburbs, we selected four, two growing (Naperville and Schaumburg) and two stable (Park Ridge and Wilmette).

We collected a sample of 1,420 responses; the response rate approached 25 percent. One member of the household responded. The responding member was requested to be an adult and preferably a worker. The respondent supplied full demographic and socioeconomic information on the household, work trip destinations, and a list of automobiles available to the household.

Most respondents filled out a 1-weekday travel diary. Thus, trip statistics are based on responses from individuals. An initial plan to request household travel diaries was abandoned because the questionnaire was becoming too long. The final version was 10 pages.

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WORK LOCATIONS

First, some of the most important differences between outer-ring, low-density, growing suburbs and inner-ring, high-density, stable suburbs are reviewed. Table 1 gives basic information for these two types of suburbs. The statistics are from a sample of 30 suburbs, 13 stable and 17 growing. The data were taken from census reports (*1,2*).

Outer-ring, low-density, growing suburbs are different in important ways from stable suburbs. Growing suburbs are far from Chicago's central business district (CBD) and have both a low population density and a high population growth rate. Furthermore, they are populated by larger and younger households, which have a higher automobile ownership compared with households of stable suburbs.

Table 2 presents the work locations of employed residents in the four suburbs examined, broken down by employment status.

The overwhelming majority (78 percent) of full-time-employed residents of growing suburbs are employed in the suburb where they live or in another suburb, and less than 20 percent are employed in the central city (Chicago). In contrast, 45 percent of residents of stable suburbs work in the central city. The statistics clearly support the hypothesis that part-time workers tend to work closer to home than full-time workers (68 and 44 percent work in the suburb of residence for growing and stable suburbs, respectively).

Only 16 percent of full-time-employed residents of stable suburbs work in the suburb of residence. In contrast, about 29 percent of full-time-employed residents of growing suburbs are employed in their home suburb. This difference may contribute to local traffic congestion in growing suburbs (i.e., more commuting on arterials and local streets than on expressways).

This pattern may be attributed to the fact that suburbs experiencing recent growth spurts have been willing and able to accommodate employment as well as residential development. On the other hand, older, inner-ring communities were

TABLE 1 CHARACTERISTICS OF GROWING AND STABLE SUBURBS

COMMUNITY CHARACTERISTICS	GROWING	STABLE
DISTANCE FROM CBD (mi)	27	15
POPULATION DENSITY (residents/square mile)	2900	5200
POP. GROWTH (1970-80)	142%	-2%
AVG. HOUSEHOLD SIZE	2.89	2.81
AVG. POPULATION AGE	31.7	37.8
AVG. AUTOS/HOUSEHOLD	2.07	1.96

All differences significant at 95% [3]

TABLE 2 WORK DESTINATION BY TYPE OF SUBURB

	RESIDENCE LOCATION AND EMPLOYMENT STATUS			
	GROWING SUBURBS		STABLE SUBURBS	
DESTINATION	FULL-TIME	PART-TIME	FULL-TIME	PART-TIME
SAME SUBURB	29.3	68.1	16.4	44.0
OTHER SUBURB	48.6	28.4	37.9	33.3
suburb total	77.9	96.5	54.3	77.3
CENTRAL CITY	19.3	2.8	44.6	18.4
MULTI-PLACE	2.8	0.7	1.1	4.3
	100%	100%	100%	100%

designed primarily as residential communities. Therefore, there are fewer employment opportunities for their residents. The employment-to-residents ratio is higher in the growing suburbs of our sample: Schaumburg's is 1.31; Naperville's is 0.93. Both are likely to be much higher now, because the pace of development in these areas between 1980 and 1990 was higher than ever before, whereas it is lower in the stable suburbs—Evanston (0.99) and Park Ridge (0.79). Evanston is atypical in this respect because it has a CBD of considerable size and a major university (Northwestern University). Aggregate census data indicate that stable suburbs tend to be consistent with respect to the employment-to-residents ratio. Most average about 0.85 with a standard deviation of 0.30. On the other hand, growing suburbs appear to form two extreme clusters: one with strong employment orientation (average ratio 1.30) and one with strong residential orientation (average ratio 0.50). The overall average for growing suburbs is 0.91 and the standard deviation is 0.60. These statistics are based on the 17 growing and 13 stable suburbs.

TRIP STATISTICS

This section presents an overview of the trip characteristics of respondents for various combinations of locations and sociodemographic groups. Analysis of the factors affecting trip characteristics is presented later. All trip statistics are from weekday travel diaries of individual respondents (1-day travel activity; the day was chosen by the respondent).

Table 3 presents mode shares for the primary work trip (i.e., the line-haul trip). Statistics do not include the characteristics of access trips at the ends of the primary trip; this explains why the share of bus, walk, and bicycle modes are not included. None of these modes was used for the primary trip by the surveyed respondents.

The automobile mode dominates by far. However, the share varies substantially: 81.0 and 87.6 percent for stable and growing suburbs, respectively. [In the growing suburb of Schaumburg the automobile share is as high as 95.0 percent because of the lesser public transportation service and the fewer workers who are employed in the central city (*3*).] The rest of the market share is picked up by public transportation, mostly commuter rail (Metra). Most residents of Naperville (one of the two growing communities surveyed) who work in Chicago commute by Metra (17.8 percent of full-time workers work in the central city and 17.4 percent of all workers commute by rail to Chicago's CBD). Rapid transit is not available to any outer-ring suburb, including the two growing suburbs in the sample; it is available to residents of both stable suburbs (Park Ridge and Wilmette).

Table 4 presents average distances and speeds for commuters with respect to the geography of their work trips. The presentation is separate for automobile and transit.

TABLE 3 MODE SHARES FOR PRIMARY TRIP TO WORK (PERCENT)

MODE	GROWING SUBURBS (n=776)	STABLE SUBURBS (n=644)
DRIVE ALONE	82.7	77.0
DRIVER AND PASSENGER(S)	4.3	3.6
PASSENGER IN CAR	0.6	0.4
TOTAL AUTO	87.6%	81.0%
COMMUTER RAIL (METRA)	12.4	11.7
RAPID TRANSIT (CTA 'EL')	0.0	7.3
TOTAL TRANSIT	12.4%	19.0%

TABLE 4 PRIMARY WORK TRIP MODE STATISTICS

Part (a): auto mode

FROM ↓ / TO →		SAME SUBURB	OTHER SUBURB	CENTRAL CITY
GROWING SUBURB	avg.distance	6.3 *	15.5 *	28.4 *
	avg.speed	19.5 N	26.0 N	31.5 *
	cases	152	314	69
STABLE SUBURB	avg.distance	4.5	10.9	12.9
	avg.speed	20.3	25.1	22.3
	cases	56	198	56

Part (b): public transit

FROM ↓ / TO →		SAME SUBURB	OTHER SUBURB	CENTRAL CITY
GROWING SUBURB	avg.distance	no observations due to minimal or non-existent public transit		31.2
	avg.speed			49.6
	cases			62
STABLE SUBURB	avg.distance			17.0
	avg.speed			28.7
	cases			73

NOTES: 1) distance in miles; speed in miles/hour is derived from respondents' reports of time and distance
2) * = t-test between growing and stable: significant at 95%
N = t-test between growing and stable: not significant

Average automobile speeds for trips within the same suburb and to other suburbs are similar for growing and stable suburbs; they are also remarkably low (i.e., approximately half the typical 35- to 45-mph speed limit on suburban arterials). However, the data do not support the hypothesis that congestion in growing suburbs is worse (average speed is higher for residents of growing suburbs). Furthermore, things look better for growing-suburb residents who commute to Chicago; these are mostly trips on expressways.

On the other hand, growing-suburb residents who work in the city are exposed to traffic and congestion for longer times. Residents of growing suburbs sit in their cars for 54 min for a typical commute to Chicago's CBD during the rush period, whereas residents of stable suburbs do the same for 35 min. In addition, because of low densities, commutes of growing-suburb residents to the same or another suburb are longer (see Table 4); therefore they are again exposed to more traffic and congestion than residents of stable suburbs. For trips to

the CBD, commutes by public transportation are substantially faster than by automobile. That is because most CBD trips are made on the commuter rail system.

Conceivably, the uproar about traffic congestion in growing suburbs may be because growing-suburb residents are exposed to traffic over longer times. As a result, they are more inconvenienced and tend to be more critical of the performance of the roadway system. Another reason may be that 10 years ago the traffic conditions in most outer-ring suburbs were acceptable if not really good; these conditions have worsened dramatically over the past few years, which may have created the impression of a crisis to residents. In contrast, worsening of traffic in inner-ring suburbs came much more gradually, so people had more time to adapt to and accept them.

Analysis of variance indicated that residence location has an insignificant effect on the daily number of trips made by individuals. It has, however, a significant effect on the distance traveled, as will be discussed later. Sex and employment status have a significant effect on the daily number of trips of suburban residents (*3*); their effect is explored in Table 5, which presents a breakdown of trip statistics by purpose for each sex and employment status combination.

The trip rates in Table 5 indicate the following:

- Females consistently make more trips than males in each employment status category, whereas not-employed people make roughly 0.5 more trips in a day than individuals employed full time.
- Females employed part time indicate a remarkably high trip activity. This may be partly because they have the burden of both household maintenance trips and work-related trips.
- Not-employed people make up for their minimal trips to and from work by making more trips for errands, groceries, personal business, and recreation.
- Employed females make nearly twice as many trips as males for errands, groceries, and shopping. Also, females make more trips than males to serve passengers (i.e., drive children, day-care person, husband to station, etc.). Full-time-employed males make slightly more work-related trips (i.e., more men are in travel-intensive jobs) than full-time-employed females. (Of all the occupations listed by our respondents, we considered as travel-intensive the following: managerial/business owner, sales, and professional/technical. Eighty percent of male respondents have a travel-intensive occupation; the corresponding number for females is 58 percent.)

These trip rates represent the trip activity of adult household members, most of whom are employed. This may explain the seemingly high numbers. The total household trip activity per person (number of trips per person) is expected to be lower because some household members cannot travel on their own or may not need to travel regularly.

Analysis of trip purposes separately for each weekday indicated that Thursday is the most representative day because it closely matches the average distribution of trips by purpose for the five weekdays (*3*). On the basis of the data, Thursday may be the best day for representative traffic measurements.

TIME-OF-DAY TRIP PROFILES

Figure 1 shows time-of-day trip profiles for selected groups of respondents. The plots show the distribution of trips in each hourly period for each population group analyzed (for example, the portion of trips between 8 and 9 a.m. is the ratio of the number of trips between 8 and 9 a.m. to the total number of trips for each population group between 6 a.m. and 9 p.m.). Figure 1a shows an interesting difference between workers residing in growing and stable suburbs: full-time-employed residents of growing suburbs depart from home earlier in the morning (and from work in the evening), presumably to compensate for their longer commutes.

The lowest line represents the difference between growing and stable suburbs in the portion of trips per hour of full-time workers. The difference again indicates that growing-suburb workers make a larger portion of their daily trips

TABLE 5 TRIPS PER DAY BY PURPOSE, EMPLOYMENT STATUS, AND SEX

TRIP PURPOSE	ALL (n=1420)	FULL-TIME MALE (781)	FULL-TIME FEMALE (301)	PART-TIME MALE (47)	PART-TIME FEMALE (91)	NOT-EMPL'D MALE (93)	NOT-EMPL'D FEMALE (107)
WORK	1.53	1.91	1.74	1.18	1.02	0.10	0.05
RETURN HOME	1.76	1.65	1.68	1.68	2.42	2.00	2.05
ERRANDS/GROCERIES	0.54	0.30	0.55	0.55	1.08	1.12	1.31
SHOPPING	0.09	0.04	0.09	0.02	0.13	0.23	0.25
PERSONAL	0.17	0.09	0.14	0.20	0.27	0.47	0.52
SERVE PASSENGERS	0.34	0.22	0.31	0.36	0.90	0.29	0.81
EXERCISE/SPORTS	0.12	0.10	0.11	0.09	0.21	0.14	0.17
RECREATION/SOCIAL	0.35	0.29	0.33	0.27	0.42	0.74	0.48
TOTAL TRIPS PER DAY	4.90	4.60	4.95 *	4.35	6.45 *	5.09	5.64 N

NOTE: (*) = difference significant at 95%; (N) = not significant

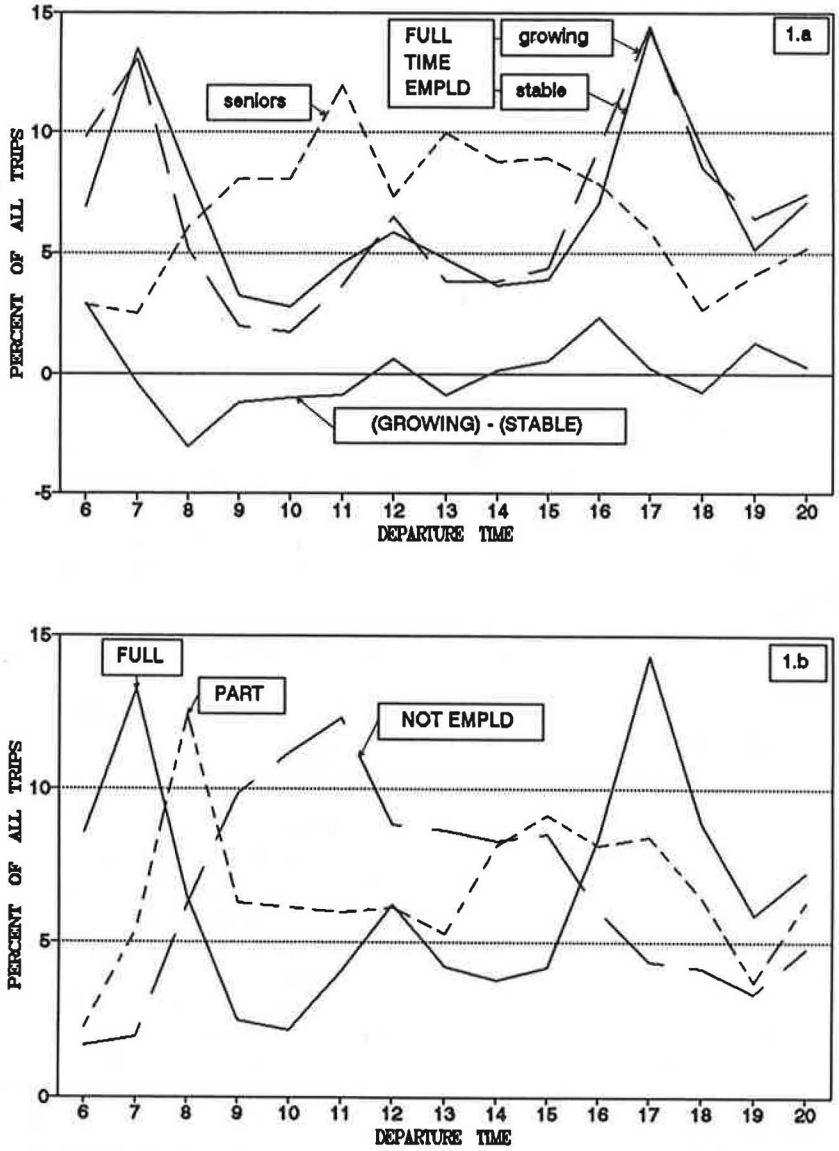

FIGURE 1 Trip profiles by time of day for selected population groups.

during the traditional three peaks of a weekday (morning, noon, and evening) than stable-suburb residents. The dense dashed line in this graph represents the trip profile of respondents from all the sample's senior households (single-person or couple households without children; at least one of the members age 65 or older). It can be inferred that they tend to avoid the morning, noon, and evening rush periods. These findings provide indications and inferences only. The averages cannot, at this point, be subjected to meaningful statistical significance testing because they are the results of trip aggregation per time slot, not per individual.

Full-time-employed people make the bulk of their trips during the morning and evening rush hours, whereas not-employed people travel mostly during the valleys in traffic demand (Figure 1b). The bulk of their trips take place after the morning and before the evening rush periods. Figure 1b also shows that part-time-employed people make the bulk of their morning trips 1 hr after the full-time workers, and they tend to spread the rest of their traveling uniformly over the hours between 9 a.m. and 9 p.m.

The resulting figures confirm the speculation that substantial traffic is observed on suburban road networks during off-peak periods. For example, excluding senior and not-employed people, the portion of trips made at 7 or 8 p.m. is higher than the portion made at 1 or 2 p.m. for all the other population groups examined. This finding applies to growing as well as to stable suburbs.

Figure 2 categorizes rush-hour automobile trips by purpose. No distinction is made between growing and stable suburbs because the differences in the profiles are not statistically significant. The figure shows that in the morning peak the destination of 77.5 percent of trips is work, whereas the destination of 62.6 percent of trips in the evening peak is home. The share of secondary purposes (other than work and return home) increases substantially in the evening peak, with the exception of trips to serve passengers, which is higher in the

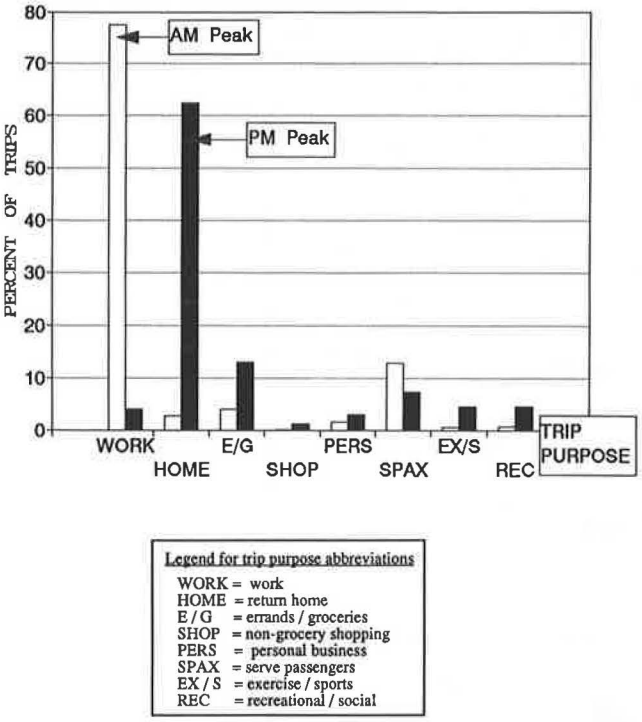

FIGURE 2 Breakdown of rush-hour trips by purpose (automobile mode only).

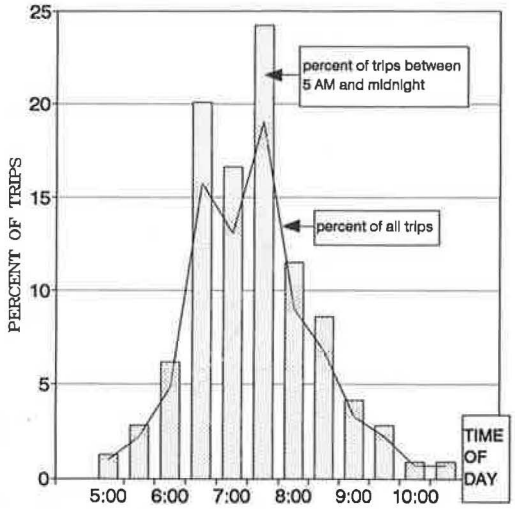

FIGURE 3 Pattern of morning departures from home for trip to work (all modes).

morning peak. It is important to realize that in the evening peak nearly 35 percent of trips are destined to places other than home or work. Part of this phenomenon is due to trip chaining (some people stop at intermediate destinations before returning home). A substantial proportion of people (12.0 percent) return home late in the evening (after 8 p.m.).

The fact that more evening rush-hour trips are for purposes other than return to home may be partly because of additional congestion—people stay in the system longer in terms of time and distance—and many persons drive to multiple destinations that may not be on the route from work to home.

Figure 3 shows the temporal pattern of the primary trip to work (the primary trip is the line-haul trip without the access trips at the ends, if such trips exist). The bulk of departures are observed between 6:30 and 7:30 a.m., so if commuting time range between 30 and 60 min, the road network is expected to carry peak loads between 6:30 and 8:30 a.m. These results prompt us to suggest that the time interval for morning traffic counts in suburban residential areas should be between 6:30 and 8:30 a.m., and for employment centers the interval for morning traffic counts should be from 7:00 to 9:00 a.m.

The figures from the morning peak period indicate little evidence of substantial peak spreading, partly because staggered and flextime work schedules do not appear to be popular among employers in the Chicago metropolitan area (*4*).

Similar analysis for the late afternoon and evening hours indicates that the bulk of departures occur between 4:30 and 6:00 p.m., whereas the bulk of arrivals—at all destinations—occur between 5:00 and 6:30 p.m. Thus, the transportation network carries peak loads between 4:30 and 6:30 p.m., which is the recommended interval for evening peak-period traffic counts.

FACTORS AFFECTING TRAVEL BEHAVIOR

This section presents results of analyses of factors that affect or explain travel behavior characteristics of individual respondents. The characteristics analyzed are number of trips (all trips, work trips, and nonwork trips), automobile share for the total number of trips reported by the individual respondent, and distance traveled by automobile.

Several potentially explanatory variables were tried using an analysis of variance procedure. Variables that have a significant effect on at least one of the trip characteristics examined are presented in Table 6, which gives the percentage of the contribution of each independent variable to the explained variance of the trip characteristics examined.

The independent variables listed on the left-hand side of Table 6 are defined as follows: EMPL.STATUS is the employment status of the respondent (full-time, part-time, or not employed). RES.LOCAT. is the residence location (growing or stable suburb). CAR AVAIL. is the availability of automobiles to each eligible-to-drive member of the household, specified for three categories: less than 0.5, 0.5 to 0.9, and more than 0.9 automobiles per driver. TRANSIT is the utilization (and familiarity) with public transportation by the respondent (1 if the respondent listed at least one trip by public transportation in his or her travel diary, 0 otherwise). AGE includes four groups for the age of the respondent: 34 or younger, 35 to 49, 50 to 64, and 65 or older.

A substantial portion of variance is explained by the variables available for the number of trips for work purposes and the distance traveled by automobile for all purposes. Observations from Table 6 are as follows.

Employment status explains much of the variation in the number of trips (particularly work trips) a respondent makes each day (see also Table 5). Part-time-employed females make more but shorter trips (6.45 trips with average distance equal to 5.6 mi) than their male counterparts (4.35 trips with average distance equal to 7.8 mi).

Sex plays an important role for the trip purposes of errands, groceries, and shopping, which are dominated by females.

TABLE 6 CONTRIBUTION OF EACH INDEPENDENT VARIABLE TO THE EXPLAINED VARIANCE OF TRIP CHARACTERISTICS (PERCENT)

Dependent->	# of TRIPS		% AUTO	TOTAL DIST.
Independent	ALL	WORK	SHARE	by AUTO
EMPL.STATUS	36.8*	32.6*	11.9@	1.4N
GENDER	0.9N	0.5N	10.2*	0.4N
RES.LOCAT.	0.2N	0.0N	15.5N	3.4@
CAR AVAIL.	0.7N	0.1N	5.7@	1.2N
TRANSIT	21.3*	22.9*	- -	78.7*
AGE	40.1*	1.0*	7.6N	6.0@
Interactns	0.0	42.9	49.1	8.9
	100%	100%	100%	100%
% Explained	7.7	49.6	14.5	46.7

NOTE: (*) = significant at 95% or higher
(@) = significant at 85%
(N) = not significant

The difference in automobile share between males and females is significant. Suburban females exhibit a behavior opposite to that of central city females—suburban females use automobiles more than do males (93.7 versus 88.7 percent). In contrast, old and recent studies (*5*) both suggest that central city females use public transportation more than do males.

This may partly be an outcome of work destinations. A larger proportion of suburban females work in the suburbs than males (78 versus 67 percent). People traveling to the central city have the option of using public transportation. This option hardly exists for intra- or intersuburban travel. As expected, more males and females of growing suburbs work in the suburbs: growing = 73 percent of males and 85 percent of females; stable = 54 percent of males and 67 percent of females.

The contribution of the residence location suburb in the portion of the variance explained for the total distance traveled by automobile in 1 day is marginally significant in the particular specification tested in Table 6. However, a specification without the TRANSIT variable as well as a *t*-test between the means indicated that the contribution and the difference, respectively, are statistically significant at the 95 percent level (i.e., the total distance traveled by automobile for growing-suburb residents is significantly higher than for stable-suburb residents). Nonwork distance is significantly different for residents of growing and stable suburbs as well.

Transit usage reduces the number of trips and increases the number of work trips. It greatly reduces total distance by automobile. These results are logical, because most transit users in the sample are daily work trip commuters going to the Chicago CBD by commuter rail.

Poor results were obtained from analysis of variance specific to each trip purpose (*3*). This may be an outcome of a lack of comprehensive information on a complex process, the intrahousehold trip-trading process (i.e., we have information from one household member only). This is also true for the total number of trips, given in Table 6. Trip trading among adult household members is largely defined by their role in the household and by their personal needs and constraints.

Trip trading is an underlying process of great importance. Ignoring this process by considering individual members only is bound to result in limited understanding of the trip-making behavior of individuals. Household travel diaries must be gathered to assess this household process.

We employed linear regression modeling to assess the effect of each contributing (or causal) factor on the travel behavior of individuals. Table 7 gives four models of trip characteristics.

The independent variables are SEX (0 = female, 1 = male), AGE (the exact age of the respondent), FULL TIME (1 if employed full-time, 0 otherwise), NOT EMPL (1 if not employed, 0 otherwise), RES.LOCAT. (1 if residence in growing suburb, 0 if residence in stable suburb), and TRANSIT (1 if at least one trip in diary made by public transportation, 0 otherwise).

The overall fit of the number of total trips model is poor, but all parameters are significant and correct in sign. Much better results were obtained with separate estimates for work and nonwork trips.

The number of work trips appears to be affected to a large extent by the employment status of the respondent. Males tend to make fewer nonwork trips compared with the sample average.

The role of a person's age in travel behavior in terms of total number of trips, work trips, and nonwork trips made in a day is fascinating, particularly for nonwork trips. The relationship between the number of trips and age is known to be nonlinear. The nonlinear effect plotted in Figure 4 is the combined effect of the AGE + AGE^2 specification, which resulted in better model performance than specifications with the AGE variable alone.

The age of a person, up to 80, is positively correlated with the number of trips made in 1 day. The number of trips contributed by the person's age to the total number of trips is highest at 40 [i.e., most people at age 40 are at the stage

TABLE 7 MODELS OF TRIP CHARACTERISTICS

Dependent	TOTAL TRIPS	NONWORK TRIPS	WORK TRIPS	DISTANCE by AUTO
R-squared	0.08	0.28	0.33	0.14
Cases	1296	1303	989	1311
Constant	3.52	3.44	0.11@	37.60
SEX (male)	-0.30	-0.44	0.14	-
AGE	0.15	0.12	0.04	-
AGE-sq'd	-0.002	-0.0015	-0.0005	
FULL TIME	-1.59	-3.41	1.82	-
NOT EMPL.	-	-	-	-13.70
RES.LOCAT.	-	-	-	6.30
TRANSIT	-	-	-	-33.90

NOTE: all parameters significant at 95%, except
(@) = parameters not significant

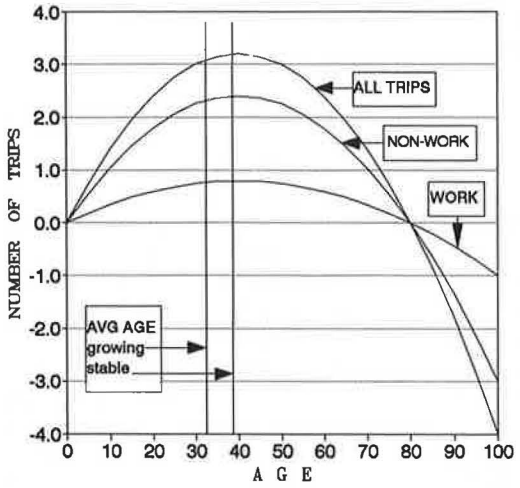

FIGURE 4 Contribution of age to travel behavior (number of trips by purpose).

of the life cycle with young, dependent children, whose needs induce a substantial number of trips among the adults in the household (*6*)]. Clearly, age has a much larger effect on non-work trips. This is intuitive, because the number of work-related trips is largely affected by the type and hours of work and transportation alternatives and costs.

The underlying age distributions are different in growing and stable suburbs. The average population age is 31.7 and 37.8 years in growing and stable suburbs, respectively, which suggests a higher trip activity in stable than in growing suburbs (Figure 4). This is an aggregate estimate that tends to ignore the real age distribution in our sample. Disaggregate estimation suggests that the correlation between the number of trips and age alone results in 449 and 534 trips in growing and stable suburbs, respectively, for every 100 residents in each type of community.

Given the U.S. population aging projections (*7*), it is likely that overall stable suburbs will progress toward higher age cohorts (i.e., beyond 40), which may result in reduced trip activity. Growing suburbs will progress closer to 40 years of average age, which will put them at the highest trip activity age cohort. Precise estimation of the effect of aging cannot be obtained with our data because important information on in- and out-migration rates is not available. Projections rely on the assumption that behaviors do not change over time. We may wonder, though, whether it is safe to assume that the baby-boom generation (the old generation of tomorrow) will have a travel behavior similar to that of today's old generation.

The distance traveled in 1 day by automobile is greatly affected by the use of public transportation. Commuting to work by public transportation saves the average respondent 34 mi of driving. This result is largely due to suburban residents employed in the Chicago CBD who commute by public transportation (commuter rail or rail rapid transit). Most of these people make few other trips by automobile during weekdays (i.e., they have little time left for such travel), and most of their daily mileage is picked up by public transportation.

Residence in a growing suburb adds, on the average, 6 mi to the daily distance traveled by automobile. This estimate translates into roughly 15 more min of exposure to traffic, plus added fuel consumption and pollution. [For each automobile user, 6 more mi a day translates into 80 gal of fuel a year additional (assuming 250 workdays and 20 mi/gal average fuel efficiency). This estimate does not include weekend travel; conceivably, weekend travel distances are also longer for growing-suburb residents.] Not-employed people travel on the average 14 mi less by automobile compared with the sample average.

CONCLUSIONS AND IMPLICATIONS

Findings from an analysis of contemporary transport behavior survey data collected from selected Chicago suburbs were presented. Two classes of suburbs were used in the analysis: inner-ring, high-density, stable suburbs and outer-ring, low-density, growing suburbs. The presentation focused on empirical findings of trip characteristics of individual respondents and on the factors affecting or explaining them.

Key findings are summarized as follows:

- More than 40 percent of stable-suburb full-time workers are employed in the central city, but less than 20 percent of

growing-suburb full-time workers are employed in the central city. The majority of part-time workers work in the suburb where they reside.

- Average speeds for the trip to work by automobile are similar for growing- and stable-suburb residents, but growing-suburb residents stay in traffic at least 25 percent longer because of their longer commuting distances.
- Full-time-employed people make the bulk of their trips during the morning, noon, and evening rush periods, part-time-employed people spread their trip activity almost uniformly, and not-employed people use mostly off-peak time periods.
- A substantial number of trips are made during off-peak times, including late-evening hours, which supports the impression of around-the-clock traffic (and congestion).
- The number of trips made in 1 day by individual respondents is significantly different across employment status categories: full-time-employed people make 4.7 trips, part-time-employed people make 5.9 trips, and not-employed people make 5.3 trips.
- Males make more work-related trips, but females make more trips to run errands, buy groceries, and shop.
- Suburban females depend more on automobiles for their transportation (93.7 percent automobile share) than do males (88.7 percent automobile share).

Most of the findings have clear associations with and implications for traffic growth and congestion in the suburbs. The four most prominent factors are residence location, population aging, working women, and fixed work hours.

Residence location in growing suburbs implies longer trips and more local trips because of low density and more local employment opportunities, respectively. Specifically, growing-suburb residents travel a 40 percent longer total daily distance compared with stable-suburb residents. The average travel speed by automobile is higher for growing-suburb residents, but they stay in traffic 25 percent longer than stable-suburb residents because of longer commutes. The longer exposure to traffic (and the consequent waste of time) may have caused the uproar against congestion in growing suburbs. Despite the fact that the number of daily trips does not differ significantly between residents of growing and stable suburbs, growing-suburb residents make 80 percent of their trips in the suburbs, whereas stable-suburb residents make less than 60 percent of their trips in the suburbs. The result is more traffic (and congestion) in growing suburbs.

The U.S. population will be increasingly moving to higher age cohorts until about 2020 (*7*). This natural phenomenon may offer some relief of traffic congestion, not because older people travel less, but because they use off-peak periods and make shorter trips. Hence, their travel behavior may equalize use of the roadway infrastructure over the day and thus may be less wasteful and polluting. The data suggest that older people now reside in stable suburbs to a greater extent than in growing suburbs; thus, in the short term (i.e., the next 5 to 10 years) some relief may come to places where public discomfort due to congestion is less pronounced. Worse, natural aging alone can be expected to contribute to increasing trip rates in growing suburbs, at least for the next decade.

The increasing number of workers, working women and mothers in particular, further contributes to congestion because long work trips are added to the traditionally large number of household maintenance trips by women. Equal employment rights and the independence gained from earning an income are incentives for women to work. In addition, the increasing cost of living and opportunities for consumption may be forcing households to have multiple workers, first to make ends meet, and then to improve their standard of living by spending on education, entertainment, fitness, and possessions.

Finally, there is room for spreading peak-period demand over longer periods. It is disappointing that flextime or staggered work hours has not appealed to company executives. Recall that the overwhelming majority of the workers in our sample start their trips between 6:30 and 8:00 a.m. (Figure 3). It is clear that it would make a tremendous difference in peak loads and network performance if this 1½-hr peak were spread over 2½ to 3 hr.

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